UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JOHN FREDERICK ACKERMAN,
BANGALORE ASWATHA NAGARAJ, and
BRETT ALLEN BOUTWELL

Appeal 2007-0687
Application 10/797,422
Technology Center 1700

Decided: July 18, 2007

Before RICHARD E. SCHAFER, ADRIENE LEPIANE HANLON, and SALLY G. LANE, *Administrative Patent Judges*.

HANLON, *Administrative Patent Judge*.

DECISION ON APPEAL

A. STATEMENT OF THE CASE

Appellants appeal under 35 U.S.C. § 134 (2006) from a final rejection of claims 17-30 and 32-38, all of the claims pending in the application. We have jurisdiction under 35 U.S.C. § 6(b) (2006).

The Appellants' invention is directed to a method for preparing a thermal barrier coating that provides at least partial protection against environmental contaminants. The thermal barrier coating includes a porous outer layer which is treated with a liquid composition comprising an alumina precursor. The alumina precursor infiltrates the porous outer layer of the thermal barrier coating and is converted in situ to alumina.

Claim 17 is representative of the subject matter on appeal and reads as follows:

> A method for preparing a thermal barrier coating protected by infiltrated alumina that overlies a metal substrate, the method comprising the steps of:
>
> 1. providing a thermal barrier coating overlaying a metal substrate, the thermal barrier coating including a porous outer layer having an exposed surface and comprising a non-alumina ceramic thermal barrier coating material in an amount up to 100%;
> 2. treating the porous outer layer with a liquid composition comprising an alumina precursor to infiltrate the porous outer layer with the alumina precursor in an amount sufficient to provide, when converted to alumina, at least partial protection of the thermal barrier coating against environmental contaminants that become deposited on the exposed surface; and
> 3. converting in situ the infiltrated alumina precursor within the porous outer layer to alumina.

The Examiner relies on the following evidence in rejecting the claims on appeal:

Spence et al. ("Spence")	US 5,324,544	Jun. 28, 1994
Hasz et al. ("Hasz")	US 5,871,820	Feb. 16, 1999

Rigney et al. ("Rigney") US 6,274,193 Aug, 4, 2001

4 Ceramics and Glasses 11, 752-53 (ASM International 1991) ("Ceramics and Glasses").

B. ISSUES

Have the Appellants sustained their burden of showing that the Examiner erred in rejecting claims 17-25, 27-30, 32-35, and 37 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Spence and Hasz?

Have the Appellants sustained their burden of showing that the Examiner erred in rejecting claims 26 and 36 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Spence, Hasz, and Ceramics and Glasses?

Have the Appellants sustained their burden of showing that the Examiner erred in rejecting claims 32 and 38 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Rigney, Spence, and Hasz?

C. FINDINGS OF FACT

The following findings of fact are believed to be supported by a preponderance of the evidence. Additional findings of fact as necessary appear in the Analysis portion of the opinion.

According to the Appellants' specification, the term "non-alumina thermal barrier coating material" refers to those coating materials (other than alumina) that are capable of reducing heat flow to the underlying metal substrate of the article, i.e., forming a thermal barrier. Suitable non-alumina ceramic thermal barrier coating materials include yttria-stabilized zirconias. Specification, p. 5, l. 30 - p. 6, l. 11.

Further, according to the Appellants' specification, the terms "alumina" and "aluminum oxide" refer interchangeably to those compounds and compositions comprising Al_2O_3. Specification, p. 5, ll. 27-29.

The Appellants disclose that the term "alumina precursor" refers to those aluminum compounds that are capable of being converted to alumina. Suitable alumina precursors include alumina sols and aluminum alkoxides. Specification, p. 12, ll. 3-8.

Hasz discloses a method for protecting thermal barrier coatings from degradation caused by environmental contaminants. Hasz, col. 1, ll. 9-11.

Environmental contaminants include contaminants from fuel and air sources. Hasz, col. 2, ll. 64-67.

More specifically, the invention disclosed in Hasz relates to the use of an impermeable coating on a thermal barrier coating, where the impermeable coating reduces infiltration of liquid contaminant compositions into the thermal barrier coating. Hasz, col. 1, ll. 11-15.

According to Hasz, thermal barrier coatings are deposited onto gas turbine and other heat engine parts to reduce heat flow and to limit the operating temperature of metal parts. These coatings are generally a ceramic material, such as yttria-stabilized zirconia ceramic coating. Hasz, col. 1, ll. 19-27.

Hasz discloses that the ideal system for a hot high temperature engine part consists of a thermal barrier ceramic layer deposited onto a bond coat which exhibits good corrosion resistance and closely matched thermal expansion coefficients. Hasz, col. 1, ll. 41-45.

Hasz further discloses that it has been discovered that degradation of thermal barrier coatings by environmental contaminants that form molten contaminant compositions can be prevented by depositing impermeable barrier coatings on surfaces of thermal barrier coatings. An impermeable barrier coating inhibits the degradation of the thermal barrier coating when in contact with the molten contaminant composition at operating temperatures of the thermal barrier coating. Hasz, col. 2, ll. 45-53.

The impermeable barrier coating prevents infiltration or viscous flow of liquid contaminant compositions into thermal barrier coating cracks, openings, and pores. Hasz, col. 2, ll. 54-56.

The impermeable coating is a ceramic or metal outer coating, deposited on the outer surface of the thermal barrier coating. Hasz, col. 3, ll. 40-42.

Impermeable barrier coatings include aluminum oxide. Hasz, col. 3, ll. 45-52.

The impermeable barrier coating may be deposited on the thermal barrier coating by coating methods known in the art, such as sol-gel. Hasz, col. 4, ll. 25-27.

Spence discloses a method for reducing coke formation on metallic substrates such as fuel contacting components of gas turbines. Spence, col. 3, ll. 9-12.

Coke deposition is an undesirable side effect caused by the catalytic-thermal degradation of hydrocarbon fuels during their consumption in gas turbine engines. Spence, col. 1, ll. 14-17.

A thermally resistant barrier layer is applied to the surface of the component to prevent contact of the fuel with catalytic agents such as iron, nickel, and chromium contained in the base metals from which fuel contacting components are fashioned. Specifically, the fuel contacting components are coated with a thin, high temperature resistant layer of alumina and silica, applied in specific ratios, from a specially formulated sol-gel. Spence, col. 3, ll. 12-22.

Spence discloses that while the specification speaks in terms of preparing sols of alumina and silica, it is intended that this terminology encompass those known sols of mixtures of metals and compounds of metals which will yield metal oxide mixtures upon deposition and subsequent heating. Spence, col. 4, ll. 22-26.

Spence discloses that the alumina sol component of the mixed sol may be prepared by the hydrolysis and peptization of the corresponding organo-metallic compounds in an aqueous medium. Preferred organo-metallic compounds include aluminum alkoxides. Spence, col. 5, ll. 11-17.

Spence discloses that deposition of the sol may be accomplished by infiltration, spray, brush application, dipping, or immersion-evaporation techniques. Spence, col. 10, ll. 42-44.

The method disclosed in Spence may be used to provide protective coatings to a wide variety of substrates. Spence, col. 3, ll. 26-29.

Substrates include various ceramics. Spence, col. 4, ll. 40-42.

Ceramics and Glasses discloses that alumina is produced by heating hydrates of alumina. A number of transitional alumina structures can form

initially with increasing temperatures, but all structures are transformed irreversibly to alpha alumina. Ceramics and Glasses, p. 752.

According to the Appellants' specification, thermally heated aluminum alkoxides are typically converted to the form of finely divided alpha alumina. Specification, p. 13, ll. 31-32.

Rigney discloses a method for repairing a protective coating on an article. Rigney, col. 1, ll. 9-11.

Articles include gas turbine engine components. Rigney, col. 3, ll. 27-32.

One form of the method includes removing a ceramic thermal barrier coating, repairing the underlying metallic environmental resistant coating, and replacing the thermal barrier coating. Rigney, col. 5, l. 15 - col. 6, l. 53.

The method disclosed in Rigney also includes removing and replacing the entire thermal barrier coating of a gas turbine engine component. Rigney, col. 7, ll. 5-32.

The thermal barrier coatings disclosed in Rigney include zirconia stabilized with yttria. Rigney, col. 3, ll. 63-65.

D. PRINCIPLES OF LAW

The Examiner bears the initial burden of presenting a prima facie case of unpatentability. *In re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). After a prima facie case of unpatentability has been established, the burden of going forward shifts to the applicant. *In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir, 1984).

A claimed invention is not patentable if the subject matter of the claimed invention would have been obvious to a person having ordinary skill

in the art. 35 U.S.C. § 103(a); *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 82 USPQ2d 1385 (2007); *Graham v. John Deere Co.*, 383 U.S. 1 (1966).

Facts relevant to a determination of obviousness include (1) the scope and content of the prior art, (2) any differences between the claimed invention and the prior art, (3) the level of skill in the art, and (4) any relevant objective evidence of obviousness or non-obviousness. *KSR*, 127 S. Ct. at 1734, 82 USPQ2d at 1389, *Graham*, 383 U.S. at 17-18.

One of ordinary skill in the art is presumed to have skills apart from what the prior art references expressly disclose. *See In re Sovish*, 769 F.2d 738, 743, 226 USPQ 771, 774 (Fed. Cir. 1985). A person of ordinary skill is also a person of ordinary creativity, not an automaton. *KSR*, 127 S. Ct. at 1742, 82 USPQ2d at 1397.

The question under 35 U.S.C. § 103 is not merely what the references teach but what they would have suggested to one of ordinary skill in the art at the time the invention was made. All disclosures of the prior art, including unpreferred embodiments, must be considered. *In re Lamberti*, 545 F.2d 747, 750, 192 USPQ 278, 280 (CCPA 1976).

An express suggestion to substitute one equivalent for another need not be present to render such a substitution obvious. *In re Fout*, 675 F.2d 297, 301, 213 USPQ 532, 536 (CCPA 1982).

A rejection premised upon a proper combination of references cannot be overcome by attacking the references individually. *In re Keller*, 642 F.2d 413, 426, 208 USPQ 871, 882 (CCPA 1981).

The discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art. However, a prima facie case of obviousness may be rebutted where the results of optimizing a variable, which was known to be result effective, are unexpectedly good. *In re Boesch*, 617 F.2d 272, 275, 205 USPQ 215, 219 (CCPA 1980).

In proceedings before the USPTO, claims in an application are given their broadest reasonable interpretation consistent with the specification. *In re Sneed*, 710 F.2d 1544, 1548, 218 USPQ 385, 388 (Fed. Cir. 1983).

A dictionary may be consulted when construing a claim term, so long as the dictionary is not used to contradict the meaning of a claim term that is unambiguous in light of the intrinsic evidence. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1324, 75 USPQ2d 1321, 1335 (Fed. Cir. 2005).

An applicant's description of the chemistry of his process as producing the same product as a process of the prior art is a statement of chemical fact and may be relied on to establish that the processes prima facie produce the same product. *In re Thorpe*, 777 F.2d 695, 697, 227 USPQ 964, 966 (Fed. Cir. 1985).

E. ANALYSIS

1. Claims 17-25, 27, and 28[1]

The Examiner found that Hasz discloses an aluminum oxide (alumina) coating which protects a thermal barrier coating from environmental contaminants. The Examiner found that the thermal barrier coating disclosed in Hasz consists of a ceramic layer, particularly yttria-stabilized zirconia. Answer 4.

[1] The Appellants argue claims 17-25 and 27 as a group.

Hasz discloses that the alumina coating can be deposited on the thermal barrier coating by a sol-gel process. Hasz, col. 4, ll. 25-27. However, Hasz does not discloses that the alumina may be applied as an alumina precursor and converted in situ to alumina.

The Examiner found that Spence discloses an alumina/silica coating which protects against environmental contaminants. The coating may be applied as an alumina/silica precursor that yields an alumina/silica coating upon deposition and subsequent heating. The Examiner found that Spence discloses that the coating may be applied to various substrates, including ceramics. Answer 3-4.

The Examiner concluded that it would have been obvious to one of ordinary skill in the art to apply the alumina/silica protective coating disclosed in Spence on the thermal barrier coating disclosed in Hasz to provide an alternative means for protecting the thermal barrier coating in Hasz from environmental contaminants. Answer 5.

The Appellants argue that there is no motivation to combine the teachings of Spence and Hasz because the protective coatings in Spence and Hasz do not protect against the same or even similar environmental contaminants. Br. 7.

The protective coatings in Spence and Hasz each contain alumina and are used to protect gas turbines from fuel source contaminants. Therefore, we find that one of ordinary skill in the art would have expected the coatings in Spence and Hasz to be effective against the same or similar fuel source contaminants.

The Appellants argue that Spence does not teach or suggest that the alumina/silica sol-gel infiltrates a porous outer layer of a thermal barrier coating as in the claimed method. Br. 4. The Appellants also argue that Hasz does not teach or suggest infiltrating the porous outer layer of a thermal barrier coating with an alumina precursor according to the claimed method. Br. 8-9.

The Appellants' arguments are not persuasive. First, the individual teachings of Spence and Hasz cannot be attacked in a rejection based on 35 U.S.C. § 103. Rather, the combined teachings of Spence and Hasz must be evaluated from the perspective of one of ordinary skill in the art.

Hasz discloses that the impermeable aluminum oxide (alumina) coating prevents infiltration or viscous flow of liquid contaminants into the cracks, openings, and pores of the thermal barrier coating. Hasz, col. 2, ll. 45-63. Based on this disclosure, we find that the thermal barrier coating in Hasz has a degree of porosity.

The Examiner found that the coating composition in Spence may be deposited on a substrate as an alumina/silica precursor in a liquid phase and converted in situ to an alumina/silica coating. Answer 4, 10. The Appellants do not dispute this finding.

We find that the liquid coating composition in Spence will necessarily infiltrate cracks, openings, and pores, such as the "cracks, openings, and pores" of the thermal barrier coating disclosed in Hasz. Significantly, the Appellants have failed to direct us to any evidence establishing otherwise. Instead, the Appellants ask us to ignore the Examiner's finding that the thermal barrier coating in Hasz is porous because the finding is not

supported by an Examiner's affidavit. The Examiner's finding will not be ignored because it is supported by a preponderance of the evidence.

For the reasons set forth above, it is reasonable to conclude that the method of claim 1 would have been obvious in view of the combined teachings of Spence and Hasz.

2. Claims 29 and 30

According to the Appellants' specification, the liquid composition comprising the alumina precursor is applied to the porous outer layer of the thermal barrier layer in a manner such that the alumina precursor infiltrates the porous structure of the outer layer. The period of time required for sufficient infiltration of the alumina precursor is said to depend on a variety of factors, including factors well known to those skilled in the art. Typically, the porous outer layer is treated with the liquid composition for a period of time in the range from about 0.1 to about 30 minutes, more typically from about 1 to about 5 minutes. See Specification, p. 12, l. 27-p. 13, l. 9. These treatment times are recited in claims 29 and 30.

The Examiner found that the length of treatment is a result effective variable. The Examiner also found that the optimal treatment time could be determined through routine experimentation. Answer 6-7.

The Appellants argue that the Examiner's position is based on "unsupportable and improper speculation" because Spence and Hasz do not disclose treatment times. The Appellants ask us to give no weight to the "unsupported speculation about the alleged 'obviousness' of the time periods defined in Claims 29-30." The Appellants do not argue that the claimed treatment times are critical. Br. 10-11.

We decline the Appellants' invitation. One of ordinary skill in the art is presumed to have skills apart from what the prior art references expressly disclose. Spence discloses that the alumina/silica sol may be deposited on a substrate by infiltration, spray, brush application, dipping, and immersion-evaporation techniques.. Spence, col. 10, ll. 42-44. Substrates include various ceramics. Spence, col. 4, ll. 40-42. Spence also discloses that care must be taken in the coating procedure to assure complete coverage of the substrate. Spence, col. 10, ll. 18-19.

We find that one of ordinary skill in the art would have understood that the length of time a substrate, such as ceramic, is treated with the alumina/silica sol disclosed in Spence depends on a number of factors, including the porosity of the layer treated and the manner in which the alumina/silica sol is deposited. See Specification, p. 13, ll. 1-6 (time required for sufficient infiltration depends on a variety of factors well known to those skilled in the art). We further find that optimal treatment times could be determined by one of ordinary skill in the art through routine experimentation.

For these reasons, it is reasonable to conclude that the time periods recited in claims 29 and 30 do not impart patentability to the claimed process.

3. Claims 32-35 and 37[2]

The method of claim 32 requires that a "turbine component is in an assembled state" when the porous outer layer on the turbine component is treated with the liquid composition comprising an alumina precursor.

[2] The Appellants argue claims 32-35 and 37 as a group.

Giving the phrase "an assembled state" its broadest reasonable interpretation, the Examiner found that the turbine components described in Spence and Hasz would necessarily be "assembled" when treated. Answer 15.

The Appellants argue that the Examiner does not specifically point out where Spence or Hasz, either separately or in combination, teach or suggest that the turbine component is in an assembled state when it is treated. Br. 11.

The Appellants' specification does not define "turbine component," "component," or "turbine component in an assembled state." Turning to *The American Heritage Dictionary of the English Language*, 273 (William Morris ed., New College ed. 1976) (copy attached), "component" is defined as "A simple part, or a relatively complex entity regarded as a part, of a system; element; constituent."

Spence describes coating a "turbine element" with the disclosed alumina/silica sol. Spence, col. 10, ll. 18-37. We find that the "turbine element" described in Spence is a "turbine component" within the meaning of claim 32. The Appellants have failed to explain how the phrase "turbine component in an assembled state" distinguishes the claimed turbine component from the turbine element described in Spence. Moreover, there is no reason to believe that the turbine element in Spence is not in an "assembled state."

As a final note, we find that one of ordinary skill in the art would have recognized the advantages of treating a turbine component "in an assembled

state," such as preventing deposition of the alumina precursor in unnecessary or unwanted areas of the component.

4. Claims 26 and 36[3]

Claim 26 reads as follows:

> The method of claim 23 wherein the infiltrated aluminum alkoxide is thermally converted to finely divided alpha alumina.

Spence teaches using aluminum alkoxide as an alumina precursor. Spence, col. 5, ll. 11-17. However, the Examiner found that the combined teachings of Spence and Hasz do not expressly disclose that aluminum alkoxide is thermally converted to finely divided alpha alumina. The Examiner found that Ceramics and Glasses discloses that alpha alumina may be produced by heating hydrates of alumina. The Examiner also found that the process described in Ceramics and Glasses is the same as the claimed process. Since the claimed process results in finely divided alumina, the Examiner found that the alpha alumina described in Ceramics and Glasses must also be finely divided. Answer 8.

The Appellants argue that Ceramics and Glasses does not teach or suggest that the alpha alumina formed would be finely divided. The Appellants also argue that the Examiner improperly relied on the Appellants' disclosure to establish that the alpha alumina described in Ceramics and Glasses would necessarily be finely divided. Br. 12.

The Appellants disclose that thermally heated aluminum alkoxides are typically converted to finely divided alpha alumina. Specification, p. 13, ll. 31-32. This disclosure is a statement of chemical fact which may be relied

[3] The Appellants argue claims 26 and 36 as a group.

on to establish that the claimed process and the process described in Ceramics and Glasses prima facie produce the same product.

The Appellants do not disclose that other steps are necessary to thermally convert aluminum alkoxide to finely divided alpha alumina. Therefore, based on the record before us, we find that one of ordinary skill in the art would have expected the thermally produced alpha alumina described in Ceramics and Glasses to be finely divided.

5. Claims 32 and 38

Claim 38 reads as follows:

> The method of claim 32 wherein step (1) comprises providing a refurbished thermal barrier coating that overlays the metal substrate of the turbine component.

The Examiner found that Rigney teaches repairing a damaged turbine component by removing the entire thermal barrier coating, repairing the metal component at the discrete location of the damage, and reapplying the thermal barrier coating. Answer 8.

The Appellants argue that Rigney prefers to use metallic coatings for the disclosed repair process. Therefore, the Appellants argue that there would have been no motivation to use alumina in the repair process of Rigney. Br. 15-16.

The Examiner merely relies on Rigney to establish that it was known in the art to refurbish the ceramic thermal barrier coating of a turbine component. Significantly, one cannot overcome a rejection based on a combination of references under 35 U.S.C. § 103(a) by attacking the references individually.

The Appellants also argue that the teachings of Rigney are not relevant to the subject matter of claim 32. Therefore, the Appellants request that the rejection of claim 32 based on the combination of Rigney, Spence, and Hasz be withdrawn. Br. 16.

It is not necessary to decide whether the rejection of claim 32 based on the combination of Rigney, Spence, and Hasz should be withdrawn because the combined teachings of at least Spence and Hasz render obvious the subject matter of claim 32.

F. CONCLUSIONS OF LAW

The Appellants have not sustained their burden of showing that the Examiner erred in rejecting claims 17-25, 27-30, 32-35, and 37 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Spence and Hasz.

The Appellants have not sustained their burden of showing that the Examiner erred in rejecting claims 26 and 36 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Spence, Hasz, and Ceramics and Glasses.

The Appellants have not sustained their burden of showing that the Examiner erred in rejecting claims 32 and 38 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Rigney, Spence, and Hasz.

G. DECISION

The rejection of claims 17-25, 27-30, 32-35, and 37 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Spence and Hasz is affirmed.

The rejection of claims 26 and 36 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Spence, Hasz, and Ceramics and Glasses is affirmed.

The rejection of claims 32 and 38 under 35 U.S.C. § 103(a) as being unpatentable over the combination of Rigney, Spence, and Hasz is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a) (2006).

AFFIRMED

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